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Reducing Household Energy Consumption in Maine: What it Would Take to Achieve a 25% Reduction by 2011 (2002)

Maine State Planning Office

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Reducing Household Energy Consumption in Maine: What it would take to Achieve a 25% Reduction by 2011

**Prepared for the
Maine State Planning Office**

January 15, 2002

**by
Patricia H. Hart
Principal
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Executive Summary

The following study, commissioned by the Maine State Planning Office, explores the question raised in the budget bill, PL 2001, c. 439, Sec. GG-6: what would it take to reduce per capita residential energy use by 25% by 2011. As requested, the report provides specific attention to the low and moderate-income households and their opportunity to achieve the savings target.

Based on secondary sources, the study provides a description of current residential energy use, existing and planned energy efficiency programs and explores additional investments and programming which would be necessary to achieve the 25% target level of savings by 2011. It does not forecast energy use or the cost effectiveness of efficiency programs. The study concludes that Maine does have the potential to reduce per capita residential energy use by 25% over the next ten years, with additional investment in efficiency programs.

Energy used for space and water heating account for the greatest share of a household's total energy use, and therefore provide a significant opportunity for savings. While the report describes many potential and promising areas for further reducing energy usage for residential households, there are a few areas that stand out. The data show that space and water heating use the most energy in a typical household, as much as 80%. Thus, improvements to the home or the heating system, that help a household use less heat and hot water, are likely to have the most opportunity for savings. For the low-income groups, this is even more significant as they tend to use fewer energy-powered appliances than the non-low income groups, using even more than 80% of their total energy for heating.

Half of the savings target would likely be achieved by efficiency programming that would occur without new investment. As much as 16% reduction in energy use is likely to occur as a result of actions that households will take on their own as well as from programs already planned for Maine over the next ten years. As much as 5-8% of the savings in energy is likely to come from actions that households will take, on their own, over the next ten years to improve their households or replace older appliances including space heaters, water heaters and refrigerators. Another 5-8% of the target level of savings are likely to come from programs already planned for Maine. These programs include the Maine Electric Energy Conservation Plan, the Maine Oil Dealers Association extensive consumer education campaign and the federal appliance standards and ENERGY STAR energy-efficient appliance-labeling program.

The other half of the savings target would require new investment in efficiency programming. The additional incremental energy reduction (9-13%) necessary to reach the 25% target level could come from investments in new efficiency programs in the state. This report describes several options for programming and provides a general estimate of savings potential and costs. Further refinement of the costs and benefits, based on policy objectives and program design, will be needed to determine the cost effectiveness of new programming.

The report offers the following three approaches to enhance or add new efficiency programs to the state-

- *Promotion and consumer education* on efficiency, leveraging existing programs;
- *Investment in incentives or subsidies* (e.g. tax credits, subsidies, grants and loans) to encourage adoption of a specific application or target a particular population group such as the low and moderate income households; and
- *Adoption of more stringent appliance standards and/or more stringent building energy codes* to improve the efficiency of the appliance stock as well as building performance in the new-construction market.

These three approaches have been successful in achieving energy savings in Maine as well as in other states over the past two decades. A suite of programs designed to achieve the target could cost between \$5 and \$20 million over the next ten years. Further refinement of the costs would depend on program goals and implementation design.

The low and moderate-income households would require specific attention and investment to achieve the savings target. Much of the savings that will occur without new state intervention is a result of households purchasing new appliances including heating systems as well as investing in improvements for their dwellings. For households who cannot afford to take advantage of the efficiency improvements attained by investing in home improvements or appliance replacement, the savings per household would be lower than the statewide household savings. Thus, targeted investment in efficiency would be required to achieve the same level of savings for those with fewer means, the low and moderate income households.

There are several sources providing program funding today that may hold promise for future funding-

- System benefits charge on electric distribution company bills in the state;
- U.S. DOE weatherization program funding,
- U.S. DOE State Energy Program funding,
- Industry and trade group funding such as the National Oil heat Research Alliance, and
- Private funding such as from The Energy Foundation.

At a minimum, staff funding is required to channel additional resources from federal and private sources to the state and to evaluate programs already planned.

Energy Efficiency needs more focused attention as a state policy matter. In the process of researching this topic, it became apparent that there is very little current public data on energy use or future use in Maine. Moreover, there is little state data available that tracks the total energy used by a household or special segments of the population such as low-income groups. Additional research and tracking are necessary to understand household energy use and opportunities for reducing energy use, particularly for the low-income and moderate-income groups in the state.

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Introduction and Background

The State Planning office has been tasked to report on the following to the Legislature (PL 2001, c. 439, Sec. GG-6):

Sec. GG-6- State Planning Office shall conduct a study regarding reduction of energy consumption, The State Planning Office shall conduct a study to determine whether this State can reduce its per capita residential energy consumption by 25% by 2011. Particular attention must be paid to low-income to moderate-income households that lack the financial and technical resources to identify energy conservation opportunities and to acquire the energy conservation goods and service needed to achieve significant savings. The State Planning Office shall report on requiring higher efficiency rating for heating systems, appliances and energy building standards. The State Planning Office shall also analyze the possibility of requiring higher efficiency ratings for heating systems, appliances and energy building standards. The State Planning Office shall investigate the value of tax incentives for implementing measures identified in energy audits for energy conservation improvements for Maine citizens. The State Planning Office shall report to the joint standing committee of the Legislature having jurisdiction over business and economic development matters, the joint standing committee of the Legislature having jurisdiction over taxation matters, the joint standing committee of the Legislature having jurisdiction over utilities and energy matters and the joint standing committee of the Legislature having jurisdiction over appropriations and financial affairs on establishing Maine energy independence programs and financing mechanisms to achieve this goal. The State Planning Office shall submit a report with accompanying legislation to the Second Regular Session of the 120th Legislature by January 15, 2002.

This legislative request came out of the work completed by the Task Force to Reduce the Burden of Home Heating Costs on Low-Income Households established in the Second Regular Session of the 119th Legislature by Resolve 1999, chapter 132. Along with other recommendations, the Task Force was interested in learning more about how energy conservation and the efficient use of energy could help residents manage their energy costs. Specifically, the Task Force asked for an estimate of the resources required to achieve a 25% reduction in energy use in the state by the year 2011.

The following report addresses the request of the legislature and the original Task Force to investigate energy conservation potential and the associated resource requirements, with particular attention to the low-income and moderate-income populations. The report focuses on identifying energy savings potential and is based on the best available data.

This report seeks to:

- profile current residential energy usage,
- identify a range of efficiency measures including increased efficiency ratings for heating systems, appliances and building standards;
- provide a description of the resources and incentives required to achieve the targets, and;

- outline a means to establish a “Maine Energy Independence Program and financing mechanism” to achieve the energy savings goal.

Methodology

The following report provides a static analysis of energy savings potential. It develops a snapshot of residential household energy use in 2001 and identifies promising opportunities to achieve a 25% reduction in energy use over the next ten-years. It does not provide a forecast of energy use, nor does it explore consumer responses to changes in energy prices, economic circumstances, product availability, changes in technology or cost effectiveness of the programs.

Based on secondary data sources, the report provides an illustrative overview of residential energy use in the state. In many instances, where there were no Maine-specific data, the report cites Northeast region or national statistics. The observations are based on these types of regional-descriptive information.

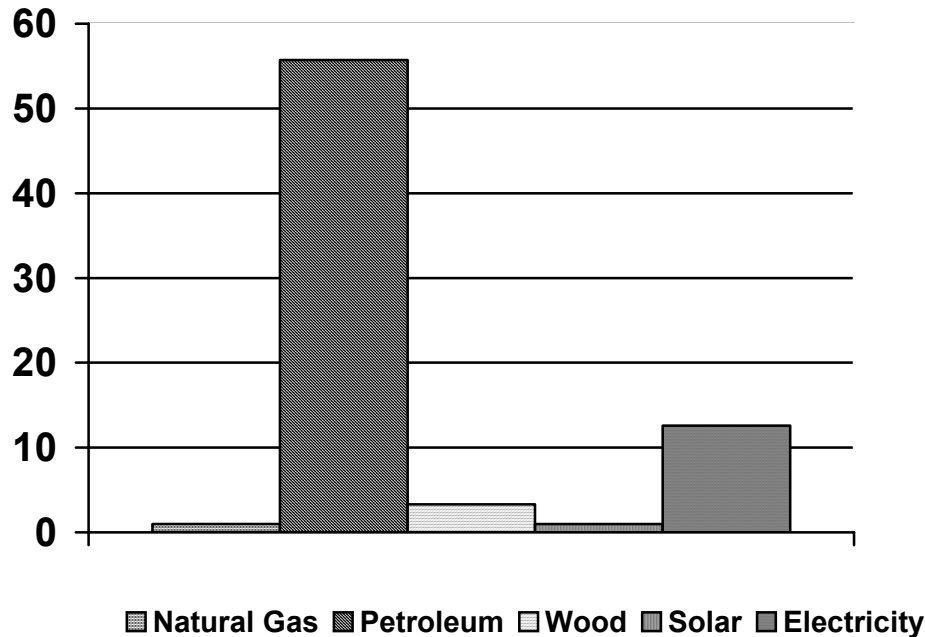
Part I – Profile of Residential Energy Use in Maine

The first step in assessing the opportunity for energy efficiency in residential households in Maine is to understand energy usage and the factors that influence energy usage. This section provides a description of residential energy use, identifies influential factors and points out opportunities for energy reductions.

Total Residential Energy Use in Maine

Residential households in Maine use more than 75 trillion Btu's of energy per year. According to the Energy Information Administration of the Department of Energy, residential households in Maine used the following mix of energy in 1999.¹

Figure 1. Residential Use of Energy in Maine (trillion Btu), 1999



Source: Energy Information Administration, Department of Energy, 1999

Figure 1 shows that petroleum-based products account for the greatest portion, of all energy used by Maine households, 76%. Petroleum or home-heating oil is used primarily for space and water heating in the state. After petroleum, the next largest share of energy used is electric energy. Electricity is used to operate small and large appliances, including lights, refrigerators, clothes washers, dryers, dishwashers as well as space and water heaters. Approximately, 17% of the energy used by residential customers is used directly by appliances in the home.

¹ Department of Energy, Energy Information Administration, 1999 data found at www.doe.gov/eia.

Profile of Households in Maine

Residential energy use is influenced by many factors including demographics, housing characteristics, appliance inventories, climate and consumer behavior. The following section -

- identifies household characteristics,
- analyzes the mix of home heating fuels,
- describes typical appliance usage; and
- outlines opportunities for efficiency improvements.

Household Characteristics

According to the 2000 U.S. Census, there are just over a half million households in Maine. As illustrated in Table 1, most houses are owner occupied, with only 28% occupied by tenants. The majority of houses are single unit dwellings, with 2.39 household members on average. The U.S. Census estimated Maine's 2000 median household income to be \$36,400, making its median income level the lowest in New England and lower than the national median \$38,005. Out of all the households in the state, 41% are considered low income, defined as 80% of area median income.² Compared to neighboring states in New England, Maine is less populated and has lower income levels.

Table 1. Household Characteristics in Maine

Household Characteristics	Maine Statistics – 2000
Number of Households	518,200
Percent owner occupied	71.6%
Percent of total units are multi-unit dwellings	21%
Median household income (1997 projection)	\$36,400
Percent households < 80% of median income ³	41%
Percent persons below federal poverty levels	10.3%

Source: U. S. Census Bureau, State and County QuickFacts, found at www.quickfacts.census.gov/qfd/states/23000.html, December 2001.

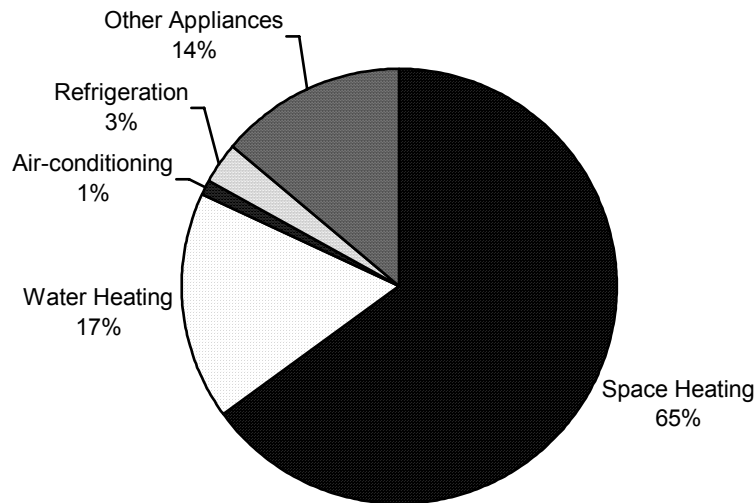
² Based on definitions commonly used by the U.S. Department of Housing and Urban Development.

³ Defined as low-income, based on definitions commonly used by the U.S. Department of Housing and Urban Development.

Household Uses of Energy

Taking a closer look at energy usage within a household, Figure 2 illustrates the energy mix for a typical household in the Northeast Census Region:

Figure 2. Average Household Energy Usage by Appliance in the Northeast U.S.



Source: U.S. Census Residential Energy Survey, Northeast Census Region, 1997

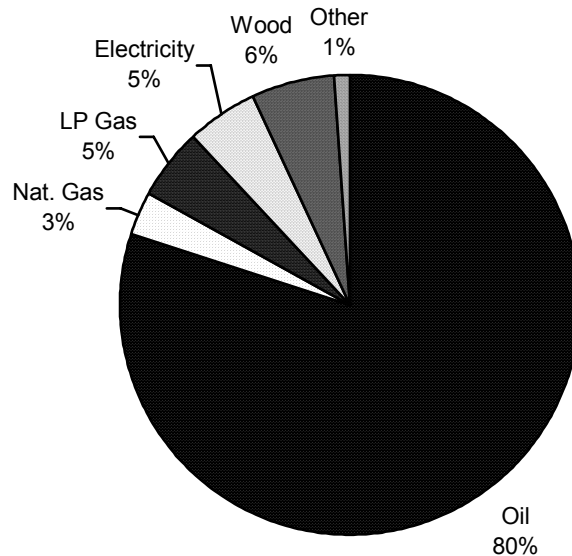
Space and water heating use more than 80% of all energy in a typical household in the Northeast. While the demographics in Maine vary from the northeast region in general, the EIA Residential Energy Survey for 1997 for the Northeast provides an adequate description of typical household energy mix in Maine. However, the level of household energy usage in Maine differs from New England. The household structures in Maine tend to be smaller than in the Northeast region. In addition, energy prices tend to be higher in some areas for electricity and heating oil. These economic and household differences combined with lower income levels, result in lower total energy usage for Maine. For example, the average electricity usage for a household in New England is 7,062 kWh/year. In Maine, the average use for the majority of households is 6,034 kWh/year.⁴

⁴ Davulis, John, Sales Forecast, Volume III-A, Central Maine Power Company, Augusta, Maine, Pre-filed Direct Testimony to the Maine Public Utilities Commission, Investigation of Central Maine Power Company's Stranded Cost Revenue Requirement and Rate Design, docket No. 2001-232 Phase II. October 3, 2001.

Home Heating Fuel Use

The most common fuel used for space heating in Maine is oil, with 80% of households using oil or kerosene as their primary fuel source.⁵ While investment in the natural gas infrastructure has increased over the past few years, the natural gas home heating market still accounts for a minority of households.

Figure 3. Heating Fuel Mix in Maine by Household, 2000⁶



In addition, many households have a secondary source of heat, reducing their dependence on a single fuel source for space conditioning. When pricing or availability of one fuel source changes, the household, in many cases, has the opportunity to replace or supplement their primary space heating fuel with alternative fuels.⁷

Appliance Holdings

The category “all other appliances”, including refrigerators accounts for more than 17% of total energy used in a typical household in the Northeast. These appliances include everything from clothes washers, clothes dryers, dishwashers and computers to lighting. While the individual appliances do not use a great deal of energy, in total the appliances can add a significant amount to household

⁵ U.S. Census 2000 Supplemental Survey Summary Table, found at http://factfinder.census.gov/home/en/datanotes/exp_c2ss.html.

⁶ U.S. Census 2000 Supplemental Survey.

⁷ In New England, 10% of all households use electricity and 14% use wood as a secondary or supplemental space-heating source.

energy usage. In fact, according to the Energy Information Administration of the Department of Energy (EIA), the “all other category” of appliances, excluding refrigeration and all space and water heating has increased by 5% per year from 1990 to 1997. Nationwide it accounts for 30% of the typical household energy bundle, by 2020; it is projected to account for 40%. Generally, Maine households tend to use less energy than their counterparts nationwide, due to higher energy prices and lower income levels. However, the proliferation of electric appliances will impact future levels of usage in Maine. Table 2 describes the appliance holdings in New England.

Table 2. Appliance Saturation per Household in New England 1997 ⁸

Appliance	Percent Households in New England
Households with Electric Air-conditioning Equipment (not central air)	48.8
Clothes Washer	74.5
Clothes Dryer	65.2
Dishwasher	47.5
Ceiling Fans	45.5
Freezer	21.9
Oven- Electric	99.5
Pumps	33
One Refrigerator	84.8
More than one refrigerator	15.2
Refrigerators more than 10 years old	29
Color Televisions	98
VCRs	85.9
Personal Computer Usage	35
Rechargeable appliances/tools	43.1

⁸ Source: U.S. Department of Energy, Residential Energy Consumption Survey, 1997

The Opportunity for Saving Energy

The opportunity for reducing energy use depends on many factors in a household: size and air infiltration of the dwelling, fuel-type for heating system, opportunity for controlling space and water heating temperature, efficiency of appliances, occupant behaviors and income levels. The opportunities can be divided into three categories: household and heating improvements, appliance replacements and changes in behavior.

Opportunities to Save Energy Through Housing and Heating Improvements

As illustrated in the previous sections, space heating accounts for the largest share of energy used within a household. Thus, reducing household-heating requirements can provide the largest contribution to energy savings. *Improvements to the home would help save all types of fuels used by heating systems, because less heat would be needed as less cold air comes into the house.* Reductions in heating requirements can come from a variety of actions including increasing insulation levels, decreasing outside air infiltration, simply reducing indoor air temperatures and improving the efficiency of the heating system itself. Table 3 describes the attributes of households in New England.

Table 3. Home Heating and Dwelling Attributes⁹

Home Heating Characteristic	Percent of Households in New England
Houses Built Before 1960	45
Heated Floor Space Less than 2,000 sq. ft.	70.0
Age of Main Heating Equipment 10 years or older	54.4
Thermostat Available	87.5
Use of Set-back or Clock Thermostat	33.9
Winter Temperature Settings, Lower when No One Home	52.4
Lower During Sleeping Hours	49.8
Temperature at 68 degrees or less When someone is home	55.3
Water heaters – older than 10 years	19

⁹ Source: U.S. Department of Energy, Residential Energy Consumption Survey, 1997.

Heating System Upgrades

One of the greatest opportunities for energy reduction is in increasing the efficiency of the heating system. With significant increases in efficiency in oil and natural gas fueled home-heating systems in the past ten-years, there is great opportunity to reduce energy usage when older systems are replaced with new ones. Since the majority of homes have heating systems that are more than 10 years in age, there will be a great improvement as these appliances reach the end of their useful lives and are replaced with newer, more efficient systems. The Maine Oil Dealers estimate a 20-40% reduction in energy use by the newer, more efficient heating appliances. Table 4 includes a list of steps recommended by the Maine Oil Dealers to reduce energy use.

Tune-ups and simple maintenance on existing heating systems also provide 10-20% savings on an annual heating bill. Annual maintenance by a heating system specialist can pay-off for gas and oil-fired heaters. Annual chimney cleaning will also improve efficiency and add to safety for all heating options that vent through a chimney: oil, gas, wood and coal.

Insulation Levels

In addition to tuning or replacing the older heating system, a household can take additional steps to reduce energy used for heating. Improving the thermal integrity of the structure of the house will also reduce the energy needed to heat a home. The DOE estimates that most households can reduce heating energy use by 20% by increasing the amount of insulation in the attic and walls. Additional savings will occur by replacing old windows and doors with new ones providing more protection from outside air-infiltration. With the majority of households in Maine having been built before 1960, there is a high likelihood that many of the homes in the state would benefit from increased insulation and other efficiency improvements.

Temperature Control

Table 3 shows that more than two-thirds of households do not have a clock thermostat and almost half do not turn down the temperature when no one is home. The DOE estimates that households such as these can save up to 30% on their heating bills by simply installing a programmable-automatic thermostat.¹⁰

Changing Habits can lead to Savings

In addition, many homes still maintain temperatures above 68 degrees. Moreover, 51% do not turn down their thermostats at night. Simply turning down the temperature on the thermostat 5 degrees at night during the heating season can save a home approximately 7% of the total heating energy use.

¹⁰ ENERGY STAR is a program developed by the U.S. EPA and DOE to promote energy efficiency through appliance labeling and other activities.

Table 4. Maine Oil Dealers Recommended Improvements to Oil Heat Systems

Recommended Improvement	Estimated Savings
Heating System Tune-up	2 to 10%
Reduced firing rate or nozzle reduction	6 to 10%
Reduced temperature of circulating water/furnace air	5 to 12%
Pipe and duct insulation	5 to 10%
Flame retention head burner	15 to 20%
New high-efficiency hot water boiler	20 to 40%
New high-efficiency warm air furnace	20 to 40%

Source: Maine Oil Dealers web site- www.meoil.com

Opportunities to Save Energy Used for Air-conditioning

Only 1% of total residential energy used in New England is used for air-conditioning, Maine households use even less than the region as a whole. Nonetheless, for the Maine households that do use air-conditioning to moderate temperatures in the summer months, many of the space-heating recommendations can help reduce energy use for cooling.

These recommendations include-

- using controls and clock thermostats to increase temperature when no one is home,
- putting adequate insulation in the walls and attic to reduce outside air infiltration, and
- turning-up the thermostat a few degrees.

Opportunities to Save Energy Used for Water Heating

In addition to taking measures to reduce energy use for home heating, water heaters provide another opportunity to reduce energy usage. Water heaters account for the second highest portion of household energy use after space heating, using 17% of the total household energy. Several measures can be taken to reduce energy used for water heating:

- reduce temperature setting on the tank,
- restrict the water flow for tap and showers, only run full washing loads,
- wrap the unit with a thermal water-heater wrap if the unit is more than 10 years old, and
- replace the unit with a new more efficient model.

Opportunities to Save Energy used by Other Appliances

Savings opportunities for all other appliances can come from replacing existing appliances and light bulbs with energy efficient models or from simply reducing use of existing appliances.

Refrigeration

Over the past 20 years, manufacturers have vastly improved the energy efficiency of refrigerators due to more stringent appliance standards. The current models not only use less energy than older models, but they are bigger and have more features. Consumers purchasing new refrigerators will most likely save energy.

Lighting

Lighting is a large part of non-heating energy use in the household. Energy efficient bulbs, while more costly initially, do use less electricity and will provide savings over the lifetime of the bulb. Compact Fluorescent bulbs are the most popular and the most widely available. Using these bulbs can reduce household lighting energy use by as much as 75%.

Electronics

Most of the power used to operate smaller appliances such as TVs, radios, telephones, and stereo equipment is used when the appliance is in standby mode. Efficient models of these appliances can save a household on energy and reduce energy consumption while the appliance is not in use.

Clothes Washers and Dryers

A typical household uses a clothes washer and dryer to launder their clothes. The use of the appliances as well as the model type can impact energy use. Running these machine only when it is full will not only reduce the number of loads, but also increase the efficiency of the operation of the appliance, both saving energy. Allowing clothes to air dry will save energy. In addition, there are alternative washers on the market that use up to 50% less energy per load. These washers may be front loading, similar to the Laundromat style washers, or they may have sensor technologies that control water temperature. With either efficient design, a household would save energy as well as water.

Dishwashers

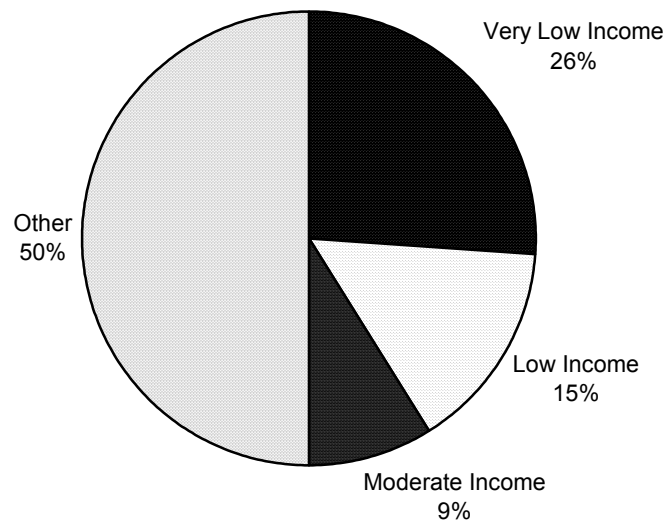
A household can save energy by operating an existing dishwasher at full capacity or by purchasing a new more efficient washer. Simply shutting off a dishwasher before the dry cycle, can save energy as well. Complying with federal laws, the newer models now have no-heat dry cycles, building-in an energy saving option. Some newer models will heat the water internally, allowing a household to set its water heater tank at a lower temperature, saving energy on water heating.

Part II. Energy Use by Low Income Households

Definition of Low Income and Moderate Income Households

For purposes of this study, low income is defined using the HUD guidelines, by comparing household income to the median income. Very low-income households are defined as those earning 0-30% of median income, low-income households earn 50-80% of median income and moderate-income households earn 80 to 100% of median income. According to the earliest figures released from the 2000 U.S. Census Supplemental Survey, 26% percent of all households fall into the very low-income category, another 15% are in the low income category and another 9% are considered moderate income households. Figure 4 illustrates the income mix in Maine. As mentioned in the first section of this report, Maine's median household income level is less than the national figure, leaving Maine's middle income households with less income than the typical household in the nation.

Figure 4. Household Income Mix in Maine, 2000

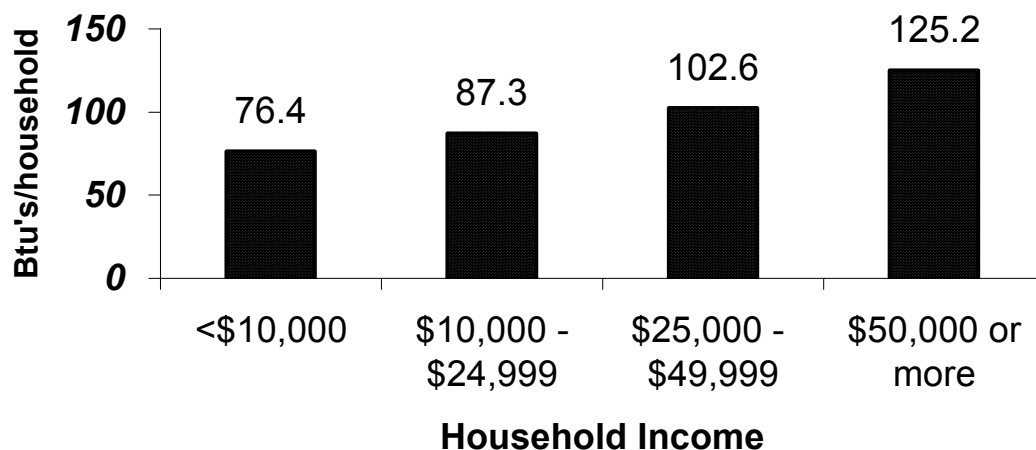


Source: U.S. Census 2000.

Energy Use by Income Level

Income is an influencing factor in the level of total energy use. The EIA Residential Energy Consumption Survey in 1997 shows that the higher the income, the higher the energy usage. Higher income households tend to have bigger dwellings, more appliances and thus higher energy usage. See Figure 5.

Figure 5. Energy Use per Household by Income Level (Million Btu/year)



Source: EIA Residential Energy Consumption Survey, 1997

Households with higher incomes tend to use as much as 33% more energy than the lower income groups. Table 5 illustrates the typical appliance holdings of low-income households nationwide. Comparing typical appliance holdings, the low-income households are likely to have far fewer appliances in their homes than the general population.

Table 5. Appliance Saturation per U.S. Household by Income Level, 1997¹¹

Appliance	\$10,000- \$24,000 Household Income	Average Household
Clothes Washer	69	77.4
Clothes Dryer	61	71.2
Dishwasher	35.5	50.2
Freezer	30	33.2

Energy Burden for Different Income Level Households

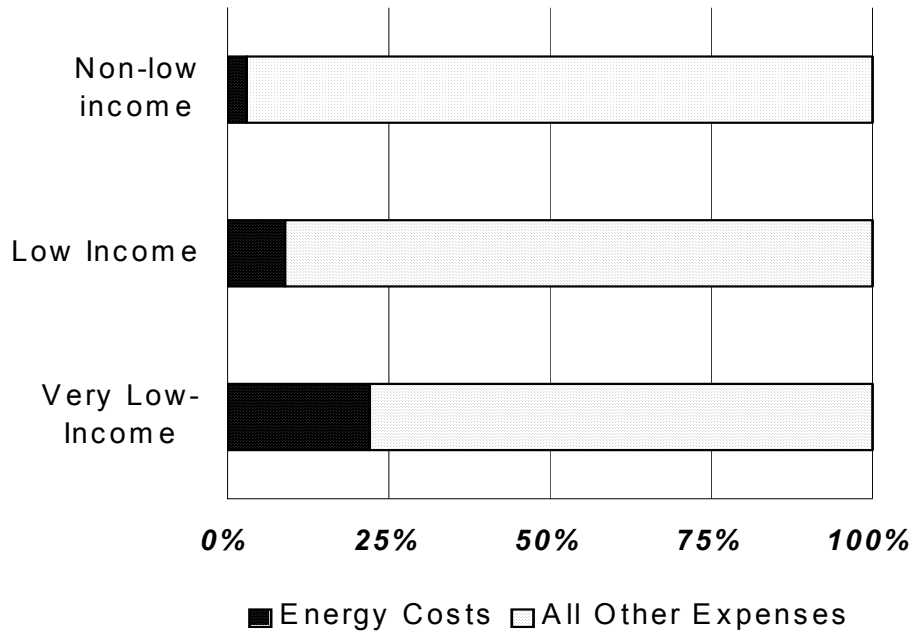
Despite the tendency for low-income households to use less energy than higher income households, the share of income used to pay energy costs is disproportionate. When compared to the high usage- higher income households, the very low-income households pay a far larger share of their income for energy costs, 22%, with the low-income paying 9%. As illustrated in Figure 6, the non-low income group pays only 3% on average.¹² While total energy usage is lower, the energy cost burden on the low-income households is much higher. Energy efficiency actions or conservation measures installed by the low-income group would not only have the benefit of reducing total energy costs, but the savings would reduce a significant percentage of their household expenses.

There are customers with uncharacteristically high levels of usage within each of the income categories. For the high-usage low-income customers, the burden is particularly problematic, creating a greater burden on limited income. In Maine, there are several programs designed to assist this group of households. The following section lists some of the programs offered to assist these households with their energy expenses.

¹¹ Economic Opportunity Research Institute, A Profile of the Energy Usage and Energy Needs of Low-Income Americans, Washington D.C. March 28, 1999, available at the LIHEAP Clearinghouse web site: <http://www.ncat.org/liheap/pubs/profiles.htm>

¹² Economic Opportunity Research Institute, A Profile of the Energy Usage and Energy Needs of Low-Income Americans, Washington D.C. March 28, 1999, available at the LIHEAP Clearinghouse web site: <http://www.ncat.org/liheap/pubs/profiles.htm>

Figure 6. Share of Household Expenses for Energy Costs



Low-Income Energy Assistance Programs in Maine

There are several programs currently offered in Maine to address the energy-burden issue for the lowest-income households. While most of the funding is provided to help households reduce their energy cost burden, there are a few programs, including education programs, designed to reduce energy use for those who use the most energy.

LIHEAP. The Low-Income Home Energy Assistance Program provides financial assistance to the households with the lowest incomes in the state to help them pay their heating bills. In 2000/2001 heating season, this federally funded program provided an average benefit of \$432 to 53,000 households in the state. Funding for this program can vary significantly each year depending on congressional appropriations. The program is administered by the Maine State Housing Authority and is delivered through 11 local Community Action Program agencies (CAP agencies) ¹³

Weatherization/Central Heating Improvement Programs. The federally funded weatherization and central heating programs provide services to reduce the energy usage in the lowest income households. Typically, the weatherization program adds insulation, weather stripping or completes home repairs, reducing heat losses and subsequently lowering energy costs. The CHIP program is used to

¹³ State Planning Office, “State of Maine Energy Programs Resource Guide”, 2000.

replace or repair central heating systems. These programs are administered by the Maine State Housing Authority and implemented by the CAP agencies. In 2000, 1900 homes received the weatherization services at an average cost of \$2800. The CHIP program improved the heating systems for 1,100 low-income households, with an average grant of \$1,900. The total program funding in 2001 is approximately \$7.3 million.

Repair Loan Pilot Program Piloted in 2001 by the Maine State Housing Authority (MSHA), the repair program provided grants to low income households and low interest loans to moderate income households for home repairs including replacement windows, heating system upgrades, and insulation. The service included an audit, the low income households must install all recommendations from the audit report and the moderate can select some or all of the recommendations to receive the loan.

REACH I. The Residential Energy Assistance Challenge Program (REACH), a three-year, grant program funded by the U.S. Department of Health and Human Services, was designed by MSHA to help low-income households reduce energy use and thereby lower energy costs. The program had a four tier design structure:

Tier 1. Education services to all LIHEAP recipients on the changes due to restructuring. This education service was provided to all 53,000 recipients.

Tier 2. Energy audits for the households who use more than 10,000 kWhs of electricity per year. Over the three year program, 1200 households fit this criteria. The homeowners were required to agree to implement the conservation measures.

Tier 3. Appliance replacement or repairs for those households that use more than 15,000 kWhs of electricity per year (the average household in Maine uses just over 6,000 kWhs/year¹⁴). There were 258 households that qualified for appliance improvements during the tenure of the program.

Tier 4. Converted electric heating systems to a new heating system with a different fuel source. Qualifying customers were customers whose annual electricity usage exceeded 15,000 kWhs/year and used electricity for their space heating.

LIAP. The Low Income Assistance Plan, a program to be administered by the Maine State Housing Authority, is designed to provide assistance to the highest use, lowest-income electric customers to help them pay their electric bills. The

¹⁴ Davulis, John, Sales Forecast, Volume III-A, Central Maine Power Company, Augusta, Maine, Pre-filed Direct Testimony to the Maine Public Utilities Commission, Investigation of Central Maine Power Company's Stranded Cost Revenue Requirement and Rate Design, docket No. 2001-232 Phase II. October 3, 2001.

program provides bill-payment assistance and puts customers on a payment plan to help them meet their payment obligations. Similar programs have been operated by the electric utilities for the past ten years and will be transferred to the Maine State Housing Authority in 2002.

Federally Sponsored Programs- Low Income and Moderate Income Programs

HUD's Five Year Plan for Energy Efficiency

The 1990 Affordable Housing Act instructed HUD to prepare a 5-year plan to implement energy efficiency measures in HUD sponsored or financed housing. In response, HUD developed and implemented a set of standards to mandate that energy efficiency be incorporated in its housing programs. The HUD program included-

- adoption of the model energy codes for new construction projects,
- beginning a nation-wide energy efficient mortgage program, and
- providing training and tools to contractors and administrators on efficiency codes, financing and appropriate technology.

Low Income Households-The Opportunity for Savings

While the lower income households generally use less energy than the middle and upper income households, there appear to be further opportunities for saving energy. About half of the low income households qualify for heating assistance, with only a fraction of those households receiving further energy efficiency services. The remaining 50,000 of the low-income households would likely benefit from energy efficiency improvements to their homes. Like other households in the state, the areas for energy efficiency gains include:

- space and water heating system improvements or replacements
- appliance and lighting replacements
- air-infiltration measures such as energy efficient levels of insulation, and energy efficient windows and doors, and
- behavior modification such as turning down the thermostat or using less hot water.

Low Income Highest Use Households

The Maine State Housing Authority, in its 2000- 2001 Low Income Home Energy Assistance Program Descriptive Analysis, shows that there is opportunity to increase the efficiency of the more than 52,000 households eligible for the LIHEAP program. This group, representing only half of all Maine households eligible for federal assistance, has been targeted over the years to receive efficiency services from the weatherization and CHIP programs.¹⁵ Of the LIHEAP eligible households,

- 7% lacked wall insulation,

¹⁵ U.S. Census 2000, Supplemental Survey Summary Table.

- 26% needed a water heater wrap,
- 24% needed a heating system cleaning,
- 11% lacked attic insulation.

Addressing these opportunities for efficiency would yield immediate savings for these households.

Barriers to Investing in Energy Efficiency

Most of these efficiency improvements require significant up front cost. Even though the energy savings will offset the initial investment overtime; it is very difficult, if not impossible, for households in the low-income group to pay for new, more efficient appliances or to invest in household improvements like adding insulation or replacing doors and windows. The low-income households are the least likely to be able to pay for many of the measures that would help them reduce their energy use, but the most likely to experience meaningful benefits to household income.

Moderate Income Households

By definition, the moderate-income households have limited income levels. While this group is likely to be able to meet monthly living expenses, this group does have less disposable income to spend on household improvements. Thus, it follows that this group is less likely to take proactive steps to reduce energy use on their own. The moderate-income group, like the low-income group appears to have ample opportunity to reduce energy use.

Part III. Current Energy Management Programs and Services

History and Background

In the 1980's and early 1990's Maine's electric utilities actively designed and promoted energy efficiency programs for residential customers. For several years, energy efficiency programs were available to the low-income households at no cost. In the 1990s, as the electricity market entered a period of significant change through restructuring, the utilities cut back on their energy efficiency program activities. At the same time, the federal government, too, reduced its spending on energy efficiency and refocused its programs to transform or influence competitive market development of efficiency services.

In the 1980s, the Maine Office of Energy Resources implemented rebate programs for residential weatherization, furnace modernization, furnace service, and high efficiency lighting. These programs were funded through the oil over charge fund. At the same time, the federal government invested in energy efficiency projects such as research and development, grant support and program management. Maine has also offered tax credit programs to encourage investment in renewable sources of energy such as wind and solar applications, but the programs were suspended due to low participation.¹⁶

In recent developments, in the last year, the oil heat industry has stepped up to champion energy efficiency in the state. Through new funding and support from a national trade alliance, the industry representing the largest share of household energy use is now promoting energy efficiency in Maine.

Electric Industry Efficiency History

With the restructuring of the electric industry, the role of the electric utilities changed from a fully integrated electric company to one focused on transmission and distribution, putting the role of generating and marketing electricity into the competitive market. Concerned about creating additional stranded costs, the utilities cut back their conservation programs as the details of restructuring were debated in the mid-1990s.¹⁷

Recognizing the need to continue encouragement of energy conservation programming in the state, the Restructuring Act that revamped the electric industry in Maine, mandates the collection of a systems benefits charge from utility rate-payers to fund energy efficiency programs. Under direction of the statute, the Maine State Planning Office is now responsible for electric energy conservation program planning with implementation the responsibility of the electric utilities.

¹⁶ Maine Revenue Service.

¹⁷ Stranded costs- costs accrued by the utility to be paid by the ratepayers over time. These costs include investments in infrastructure as well as regulatory programs such as energy conservation and low-income assistance programs.

Federal Programs

The federal government also provided funding for energy conservation and energy management programs in the 1980s through the mid-90s. Changing their focus from providing subsidies to influencing the market for energy efficiency, the federal government reduced funding available to states and invested in programs to implement national standards and appliance labeling programs. The DOE continues to provide weatherization assistance subsidies to the lowest income households, as well as efficiency program grants to the states, but at reduced levels.

A New Investment in Efficiency – National Oil Heat Research Alliance

In addition to these state and federal activities, the oil heat industry has entered as a new active proponent of energy efficiency programs for residential customers in Maine. Complying with a federal law passed by Congress in 2000, on March 1, 2001 retail oil heat distributors in key oil heat states began assessing a fee of \$0.002/gallon on all oil used to heat buildings. The funds raised from the assessment are to be used for consumer education, oil heat research and development and technical training to benefit consumers and the industry under the guidance of the National Oil heat Research Alliance (NORA). NORA collects the fees and invests them in research projects with a large share of the funds going back to benefit the individual states. The allocation of the grant money is determined by the quality of the applications submitted and the amount of money contributed by the applicant's home state. In 2001, the Maine Oil Dealer's Association was awarded more than \$500,000 from the NORA funds to finance their consumer education program. The Maine Oil Dealers have been promoting efficiency education through their program called the Smart Energy Program. In addition, they received more than \$100,000 in funding for service technician training.¹⁸

Energy Efficiency Programs in Maine

A variety of industry and government groups provide energy efficiency programs to Maine consumers. Many of these programs provide energy savings tips and advice on the purchasing efficient appliances. Others offer services to targeted customer groups. The programs offered in 2001 include-

The Bundle ME Up campaign

The Bundle ME UP Campaign was a broadcast education campaign to help households manage their energy costs in response to the oil price shock in the 2000/2001 heating season. The program provided residents of Maine with energy and safety advice as well as identified resources for additional help. A team led by the Maine State Planning Office, designed and implemented the program. The campaign relied on funding and resources from the Maine Public Utilities Commission (MPUC) Consumer Education Fund, the Maine State Housing Authority, the Maine Oil Dealers Association, Central Maine Power Company, Bangor Hydroelectric Company as well as donations and sponsorships from the

¹⁸ National Oilheat Research Alliance website, www.nora.org.

energy industry and media organizations. The energy saving tips were provided to consumers through brochures delivered to homes by oil dealers, newspaper inserts, print campaign, web site, and public service TV spots.

The Smart Energy Program

This new program is an information campaign implemented by the Maine Oil Dealers Association (MODA) to provide information on oil heating. The Smart Energy campaign uses print ads, web site information and other brochures to provide information on improving the efficiency of existing oil-heat systems as well as tips on purchasing new-more efficient heating systems.

Water Heater Wrap Programs

The electric utilities continue to offer the water heater wrap program for customers requesting the service. The programs provide a thermal jacket for water heaters older than 10 years, insulation for water pipes, and low flow fixtures.

Other Programs

In addition to these proactive programs, **the Maine Department of Economic and Community Development** has an energy information service that responds to consumer requests for information on energy efficiency.

The electric and gas utilities from time to time will provide tips on using energy more efficiently in their monthly bill inserts. These publications reach all households in their service territories.

Maine Energy Education Program (MEEP). An energy education program established in 1985 that provides classroom programming to students including efficiency and conservation topics.

Planned and Existing Programs Providing Savings In Maine

There are several planned as well as existing programs that will continue to provide energy savings over the next ten years. They are as follows-

Maine Electric Energy Conservation Program Plan

In restructuring the electric market in Maine, the legislature determined that conservation programs should continue and directed the development of statewide conservation programs to be implemented by the transmission and distribution utilities. Given this mandate, the State Planning Office worked with stakeholders to create the initial “Maine Electric Energy Conservation Program Plan”. This plan provides-

“guidance for the development and implementation of a portfolio of conservation and efficiency programs that will achieve electric energy savings, flowing from the market oriented programs that take advantage of existing regional initiatives, as well as, the creation of new Maine Programs...The primary strategy in

achieving the goal is the delivery of market-oriented programs that work to take advantage of the opportunities for improvements in energy efficiency and management that occur when key project and purchase decisions are made.”¹⁹

In its November 2001 report, the State Planning Office recommended that the electric utilities implement the following programs in the state-

Conservation Program Promotion and Public Education- this program focuses on the development of appropriate public educational materials to promote conservation programs, consistent with the delivery of specific programs and measures. It also supports the development of school-based energy conservation educational programs to teach children how to use electricity wisely.

Low-Income Household Appliance Replacement Fund –is a program designed to provide a source of funds for agencies providing energy assistance (weatherization) service to low-income households to pay for the replacement of old, inefficient, malfunctioning appliances (especially refrigerators). The program will be delivered by the CAP agencies, under a working agreement with the utilities.

Energy Star Lighting and Fixtures Program- is designed to promote the use of efficient lighting products, using a market oriented program that works to coordinate marketing, merchandising, promotion, and consumer education and incentives. Maine specific activities are leveraged by participation in existing regional initiatives.

Energy Star Appliances Program- like the lighting program promoted by the same organization, this program is designed to promote the use of Energy Star labeled appliances. The Maine activities will be carefully coordinated with the regional initiatives of this federal program.

Domestic Water Heater Program- this program is designed to encourage electric hot water heater owners to purchase more efficient units. In addition to encouragement of selecting the more efficient water heating appliances, the utilities will continue to offer their water-heater wraps to households with older water heaters.

Efficiency Standards for Heating Systems, Appliances, And Residential Buildings

Another means of decreasing the energy usage in the state comes from increasing the efficiency of the appliance stock. Since Congress passed the National Appliance Energy Conservation Act (NAECA) in 1987, the Department of Energy (DOE) has set mandatory appliance standards on 13 different consumer products. The Act required the DOE to establish minimum efficiency ratings for appliances sold to consumers

¹⁹ Maine State Planning Office, Maine Electric Energy Conservation Plan, November 2001.

throughout the U.S. It also set a schedule to update the standards as technology and economics changed.

Since its inception, the NAECA has set minimum efficiency standards for the following appliances: refrigerators, freezers, room air conditioners, fluorescent lamp ballasts, central air and heat pumps, furnaces and boilers, water heaters, direct fired space heaters, clothes washers, clothes dryers, dishwashers, ranges and ovens and pool heaters.

Researchers attribute 2.5% electricity savings, or a 1.3% reduction in total energy in today's energy use due to the adoption of efficiency standards.²⁰ Moreover, efficiency standard advocates claim that the standards have introduced savings and not interfered with advancements in product offerings. For example, the typical refrigerator manufactured today uses less than half the energy of an average 1987 model, but is bigger and offers more features.²¹

The appliance standards have been successful because they address specific market failures faced by consumers when they purchase appliances. Some of the failures include the consumer need to make emergency replacements of important appliances when they fail, leaving no time for adequate research of options. Other failures address the issues of landlord's tendency to minimize investment in equipment for rental units, often leaving renters with higher operating costs. By mandating improved efficiency, the standards have also reduced the risk of introducing new products as well as encouraged innovation by manufacturers. **By 2010, ACEEE forecasts that the appliance standards will curb electricity use for residential customers by 7%.**

Appliance Labeling by Energy Star

ENERGY STAR is a partnership of the US Environmental Protection Agency and the Department of Energy to promote energy efficient appliances and practices. The program provides the ENERGY STAR labels to appliances that meet an established minimum efficiency level. The labeling program helps consumers locate energy efficient models by clearly identifying the qualifying models at the point of purchase. Consumers and business owners also have access to information and guidance from a web site as well as many informative publications. ENERGY STAR has expanded to cover new homes, most of the buildings sector, residential heating and cooling equipment, major appliances, office equipment, lighting, consumer electronics, and other product areas.

Home Energy Rating System (HERS) and Energy Efficient Mortgages (EEMs)

A Home Energy Rating System (HERS) is a means to assign an energy efficiency score to a home while it is in the initial design stage for a new home or the financing stage for an existing home. The audit scoring can help consumers attain an Energy Efficient Mortgage (EEM) allowing them to include the financing of efficiency improvements into

²⁰ Nadel, Steve, Howard Geller and Toru Kubo. "Overall Savings From Federal Appliance and Equipment Efficiency Standards", American Council for an Energy-Efficient Economy, February 2001.

²¹ Nadel, Steve, "Opportunities for Energy and Economic Savings from Adoption of Appliance and Equipment Efficiency Standards on Additional Products, American Council for an Energy-Efficient Economy, July 2001.

the original mortgage. Trained and certified lenders will increase the homeowner lending limits for financing that will increase efficiency and ultimately decrease home operating expenses.

HERS systems are not in widespread use. Fewer than two percent of new homes nationwide receive an energy rating according to industry sources and most are utility programs with ratepayer subsidies. Lenders are often unaware of energy-efficient mortgage programs available through Fannie Mae, Freddie Mac, Federal Housing Administration, and Department of Veterans Affairs. Also, builders are reticent to engage in any program that can delay their construction schedules, add costs for ratings, or that require significant changes in building practices. In Maine, there are a few lenders certified to provide the financing, moreover, the program is little known to the lending community or to home buyers.

Building Efficiency Codes

In addition to appliance standards, there are building-industry standards and state mandated building efficiency codes designed to raise the level of energy efficiency for new residential construction as well as for additions or alterations that improve the energy performance of a building.

Building Industry Standards

The building-industry standard for efficiency, known as the International Energy Conservation Code (IECC), applies to all low-rise buildings three stories or less as well as one and two family buildings. Focused on promoting energy efficiency in the construction of the home, the building standards consider the impact on energy use of the following:

- Resistance of the building envelope, walls roof/ceiling and floors to heat loss or gain through the materials and as a result of air infiltration.
- The efficiency of the mechanical systems for heating and cooling.
- The efficiency of the hot water heating system.
- The efficiency of the electrical and lighting systems.

The IECC or the 1998 Model Energy Code (MEC), on which it was based, offers three methods of compliance:²²

- An approach based on each separate building component or system;
- A systems approach that considers the building's total energy use; and
- Specified acceptable practice.

This flexible approach is designed to make it easier for builders to meet the standard for a wide-range of construction designs. The IECC provides detailed technical specifications for builders to guide them in meeting the standards.

²² Energy Desk Book for HUD Programs, U.S. Housing and Urban Development web site, found at www.huduser.org.

Building Efficiency Codes in Maine

Maine's Energy Efficiency Building Performance Standards were enacted prior to 1992 and apply to some residential homes: speculatively built homes and homes with more than two dwelling units. They do not apply to owner-built homes, log homes, or seasonal homes. The level of energy efficiency required by Maine law was based on the national model energy code considered to be the industry energy standard at the time Maine's law was enacted. Unlike Maine's energy efficiency standards for commercial construction, the standards for residential construction do not automatically update as industry standards change. While the national model energy code has been updated numerous times, most recently in 2000, Maine's residential standards have remained unchanged. The Department of Economic & Community Development is responsible for the administration and enforcement of the standards. DECD publishes a guide for consumers, *Maine Guide to Energy Efficient Residential Construction: A Manual of Accepted Practice*.

Voluntary Energy Standard

The Maine State Planning Office (SPO), in cooperation with DECD, applied for and won grant funds to develop updated energy efficiency standards for residential construction. The draft Maine Residential Energy Standard, the Maine RES, is based on the most recent national model energy code (now called the International Energy Conservation Code or IECC) published in February 2000 by the International Code Council and amended in 2001. Like the IECC, Maine RES recommends minimum design and construction parameters for buildings and building systems. Maine RES would be implemented on a voluntary basis.

The draft Maine RES was developed by an SPO consultant in consultation with stakeholders. The intent of the project was to support private sector delivery of energy efficient design and construction services. By following the standard, builders would have an opportunity to differentiate their houses, and homeowners would have the option of higher value structures with lower energy costs. The project, however, is currently on hold. It was pursued in anticipation of additional federal grant money for implementation. The U.S. Department of Energy's codes program has since experienced funding cuts, and they are only funding projects related to mandatory energy codes. Maine's voluntary energy standard remains in final draft form.

SPO's consultant estimated that houses built to Maine RES would, on average, be about 30% more efficient than those built to Maine's mandatory Energy Efficient Building Performance Standards.²³ In addition, Maine RES would apply to all residential construction and major renovations (albeit on a voluntary basis), while the standard required by Maine law applies only to new, speculatively built homes and those with more than two dwelling units. Widespread implementation of the voluntary standard

²³ Relative efficiency varies depending on the glazing to gross wall area ratio.

would likely require a substantial investment in training, educational materials, and technical assistance.²⁴

Energy Codes for Low Income Housing

According to the HUD Energy Desk Book for HUD programs, the 1998 IECC standards are required for State-owned and -funded buildings including sponsored housing projects and CDBG funded projects.²⁵

²⁴ Information in this paragraph is based on - Karg, Richard, "Summary of the Maine Residential Energy Standard, prepared for the Maine State Planning Office, November 13, 2001.

²⁵ Energy Desk Book for HUD Programs, U.S. Housing and Urban Development web site, found at www.huduser.org.

Part IV. Achieving the Goal: 25% Energy Savings by 2011

An Incremental Approach to Savings

This section provides the framework to design a set of programs – Maine Energy Independence Programs - to reduce per capita residential energy consumption in Maine by 25%, over the next ten years. *Based on experiences in Maine as well as that of other states*, this section describes various approaches to achieving the target through alternative methods and assigns an estimate of energy-savings potential along with a general discussion of potential program costs. The methods include-

No additional investment-

- Rely on efficiency gains from naturally occurring savings and planned programs;

Additional investment-

- Provide widespread education to households to encourage energy efficient purchases and household upgrades;
- Use incentives and subsidies to increase participation of specific groups or to support a particular new program or new technology; and
- Increase the minimum level of efficiency mandated through standards and codes.

Based on the secondary data outlined in Part I of this report, this section identifies promising approaches that may be used to achieve the target level of savings

Energy Savings that would occur With No Further Investment

Described in the first section of this report, there are opportunities to improve the efficiency of Maine's households through upgrades in appliances, home repair, and installation of energy management measures such as programmable thermostats. Over the next ten years, many households will address some of these opportunities on their own or by participating in some of the programs already planned for Maine.

Household Initiated Energy Savings

Over the next ten years, as households replace their older appliances with the new more-efficient models now available, they will achieve energy savings.²⁶ An individual household that replaces an old oil-fired heater may save as much as 40% on their household heating bill. Likewise, as households replace old water heaters and refrigerators, they will see savings. Some households building new homes will seek out energy-efficient design services, others will make home improvements, while still others will change behaviors and use less energy. Adding the savings from increased appliance standards, new construction, and other household initiated savings; the estimated

²⁶ Geller, Howard, Toru Kubo and Steven Nadel, "Overall Savings from Federal Appliance and Equipment Standards", ACEEE, February 2001

reduction in energy use is likely to be in the range of 6%-8%.²⁷ This projection is based on the total residential energy market, individual household savings will vary.

Savings from Existing and Planned Conservation Programs

In addition to the savings occurring through consumer actions and market place improvements, many households will take advantage of energy efficiency programs that will be promoted over the next ten years. The estimated savings appear in Table 6.

- The **Maine Electric Energy Conservation Program Plan** is forecast to achieve up to **2%** savings on electricity usage by 2011.²⁸
- The **Smart Energy Program of the Maine Oil Dealers**, with significant investment in a statewide education campaign, is likely to help consumers save as much as 5% by promoting basic energy conservation tips.²⁹
- The **ENERGY STAR program and Energy Efficient Mortgage programs** will help consumers save as much as 2% statewide.³⁰

The total savings from the planned conservation programs are likely to range from 6%-8% of total household energy usage.³¹ It is important to note that the majority of the savings are from investment in new, more efficient appliances. The group most likely to experience this savings is the higher income household groups. The low-income population is less likely to be able to pay for upgrades to appliances and therefore less likely to contribute to the naturally occurring energy savings.

Investment in Education and Information Programs

It is likely that new and enhanced programs and initiatives will be necessary to achieve the 25% reduction in energy use in the next ten years. Despite the fact that energy efficiency does yield monetary savings, there remains a significant hesitation among consumers to take conservation and efficiency actions. While economists and other scientists disagree on the reasons, they all agree that there are significant barriers to investment in these measures, despite the ultimate economic benefits.³² Reviewing programs from the other states reveals a common set of programs offered to customers to overcome the market inertia. These programs are administered through various agencies including utilities like in Massachusetts, an independent energy efficiency utility as in Vermont (Efficiency Vermont), and by a non-profit corporation such as NYSERDA in

²⁷ Based on 2% total household energy use savings from electric appliance standards as estimated by ACEEE, plus 6% savings from oil-heat customers (1/20 of the market increasing efficiency by 20% with purchase of new heater, each year over ten years)

²⁸ The savings calculation assumes that the new programs are as cost-effective as Central Maine Power's past programs

²⁹ Based on 3%/year consumer response to education campaign, with each household installing measures saving 20% on their usage.

³⁰ Actual savings will depend on marketing investment in Maine and resulting consumer participation rates.

³¹ Total savings consider overlap of the program impacts. For example, the Energy Star program is part of the Electric conservation program.

³² Department of Energy, "U.S. Electric Utility Demand-Side Management: Trends and Analysis", found at www.eia.doe.gov/cneaf/pubs_html/feat_dsm/contents.html

New York. The following discussion is based on current offerings in other states and industry literature discussing program effectiveness.

Elements of Information or Education Programs

Many factors influence a consumer's selection of a product. Perhaps the most important is familiarity with the product and its benefits. The first step in investing in energy conservation should focus on increasing awareness for products and services that are already in the marketplace that can help consumers save energy. The more consumers are exposed to messages and information about energy efficiency, the more likely they will be to make an efficient choice.³³

Programs to increase consumer awareness of energy efficient choices typically include the following -

- *Educate consumers about energy use and efficient choices-*
 - Educate consumers about energy used in a typical household, show them where the energy dollars are used;
 - Promote the purchase of energy efficient appliances, promote energy upgrades to the home, showing value through easy-to-understand examples of simple pay-back
 - Implement an information campaign on energy savings services available in the state.
- *Supplement marketing of the ENERGY STAR program in Maine, by providing increased advertising support-*
 - Implement a statewide promotional campaign on the ENERGY STAR program using broadcast media outlets,
 - Work with retailers to educate them on the benefits of the appliances;
 - Provide state-sponsored information at appliance retail outlets.
- *Increase awareness of the HERS audit program-*
 - Distribute information about HERS through lenders, Realtors and others active in the home-purchasing market to encourage an audit at the time of home-purchase or refinancing;
 - Train and certify more technicians on the HERS audit, providing more access to audits;
- *Increase awareness for more energy efficient new construction practices-*
 - Provide information on increasing the efficiency during construction or renovation of a home;
 - Train local code enforcement officials, builders and other interested parties on the more efficient approaches.

³³ Energy Center of Wisconsin, "Circuit Riders toot the Energy Star Horn", Spring 2001 Newsletter.

Education Program Cost

The goal of this type of information campaign is to provide consumers with additional exposure to information on energy efficiency by promoting the benefits of existing programs. The program design relies on existing programs and retail outlets to provide products and services to customers. The cost range for this type of program could be from \$200,000 to \$550,000 per year, or \$2- \$5 million over the ten year period depending on the audience reach and frequency of the information provided.³⁴ The costs would cover administration, overhead and costs of promotional and advertising materials. For this level of investment, the total incremental savings from this program are estimated at an additional 1-5% over the ten-year period.³⁵

Benefits of an Expanded Education Program

This type of program has been effective in promoting awareness of the value of energy efficiency to the general public. It is especially valuable in targeting specific groups with specific messages. Unfortunately, it is not as effective in helping the low-income groups. While the low-income group will likely hear the message, they have fewer resources and thus are not able to invest in new appliances. Further, they are less likely to purchase a new home. Thus, the savings estimates for the population of low-income households will likely be close to 1%. Moderate income households, could be successfully targeted with appropriate information on energy efficiency mortgages at the time of a new home purchase, making it easier to afford the additional investment.

Providing Financial Incentives for Energy Savings

Another means of inducing reductions in energy usage is to provide financial incentives to consumers. By reducing the cost to the consumer, these subsidies can entice more households to participate. Over the last few years, energy efficiency programs have evolved from outright subsidies used extensively in the 80's and 90's to programs that essentially reward customers for efficiency investments. Subsidies and grants are often used to target high-need households.

Potential Incentive Programs

Popular and effective incentive programs include the following-

- *Residential Lighting Program - providing a subsidy to purchase energy efficient light bulbs.* While the energy savings can be as much as 75%, the upfront cost for the efficient bulb can be a deterrent to initial investment. A residential lighting program can be effective in demonstrating the value of the more efficient bulb to those reluctant to make the purchase on their own. The cost of an efficient bulb is approximately \$9.00. Total program costs would include product costs as well as administration.

³⁴ Based on the experience of the Restructuring Consumer Education Program in Maine and the Maine Oil Dealers Association - Education Program budget found on the National Oilheat Research Alliance web site, www.nora.org.

³⁵ Estimate based on doubling the Energy Star and HERS savings levels and increasing the oil-heat market efficiency by an additional 3%.

- *Energy Audit Rebate Program* – provides a rebate on the cost of the audit to consumers who install energy efficient measures. Implemented in other states as a tax credit, the program provides an incentive to act on the recommendations of the energy audit. The cost of an audit is approximately \$300 per household. Program costs would include the cost of the audit and program promotion and administration.
- *Home Audit Tax Credit Program*- provides a tax credit for investment in efficient heating or cooling systems, refrigerators, or home improvements. The program requires a home energy audit or professional certification to provide audit recommendations and to verify implementation. This program would help promote and reward investment in efficient equipment or home energy performance improvements. The cost to the state would be the lost revenues from the tax credit. The amount would be predetermined either as a specified amount for a level of efficiency, or percentage of cost. The total program cost would include promotion and administration.
- *Appliance replacement program* – provides customers with new, more efficient appliances including heating systems. This program is most effective when used for targeted populations such as those with low incomes, those in areas with delivery or distribution hardships or those in public or state sponsored housing. The program, if designed with careful qualification screens, can be very effective in reaching groups that would otherwise not be able to afford efficiency upgrades. The cost of the program would be the cost of the new appliances as well as program promotion and administration.
- *Targeted retrofit program*- provides customers in target groups subsidies for energy efficient improvements to their homes or appliances. This is especially effective when serving low-income households or sub-groups of high public interest. The cost would cover the expenses for retrofitting each home as well as program costs. The average expenditure for insulation for a low-income house was \$2800 in the 2000 DOE Weatherization Program. The average cost for appliance replacement and upgrade was \$1,900. Depending on the subsidy and the audience, the cost could have a wide range.³⁶

Program Costs

The subsidy and incentive programs, while effective, are costly. The total program cost depends on the measures selected, the implementation method and the size of the customer base. A program such as the lighting program designed to reach 5,000 customers with 2 bulbs per household would cost approximately \$40 per household, or \$200,000 just for the bulbs. Additional costs would be incurred for program promotion and administration.

Benefits of Providing Incentives for Energy Efficiency

This method was used extensively in the 1980's by utilities in Maine to induce energy efficiency. While these programs are effective in achieving their savings goals, they do not further the ultimate goal of customer driven efficient choices. They are, however,

³⁶ Maine State Housing Authority, "2000-2001 Low Income Home Energy Assistance Program: A Statewide Descriptive Analysis", November 2001

very useful in providing savings to sub-populations that would not otherwise be able to invest in efficiency measures themselves. They are also effective in introducing new technologies to customers who may be reluctant to try them. For the low-income groups, especially those qualifying for heating assistance, the program can also reduce the need for public assistance for home heating.

The total savings provided by these programs depend on the amount of money invested as well as the program design. Depending on the overall policy objectives, the program could be designed to provide a partial or full subsidy for all consumers or a targeted group. These decisions would significantly alter the ultimate enrollment, savings potential and administrative costs of the program.

Mandating Higher Efficiency Standards

The fourth method of inducing energy conservation in the state, in addition to naturally occurring, planned programs, education programs and subsidized programs, is mandating higher efficiency standards. As discussed earlier, Maine benefits from significant savings due to the NAECA minimum efficiency standards. As mentioned, these are successful because they automatically ensure that the efficiency of the appliance stock improves as older appliances are replaced with newer ones. In addition, increasing the energy efficiency requirements in the building code may also increase savings for a new home.

Increasing Appliance Efficiency Standards

While the standards set a minimum level of efficiency, there are many models of appliances that are far more efficient than the standard and many appliances that are not covered by the standards. There are ample opportunities to impose even more stringent standards, saving more energy. California, responding to the energy crisis in their state, is ready to introduce new standards that are stricter than the federal standards, helping that state reduce energy use.

Currently, Maine has the opportunity to work with the **Northeast Energy Efficiency Partnership** on a collaborative project to engage the northeast states in adopting or updating appliance efficiency standards over the next few years. This regional cooperation can help provide coordinated action in establishing viable markets for appliance manufacturers. The region, as a whole, presents a large consumer base, attractive to manufacturers. In addition, the partnership can help individual states to implement economic, energy and environmental policies that have regional buy-in as well as regional benefit. The cost of the program, initially, will be the cost of working with the Partnership to represent the needs in Maine.

Increased Energy Efficiency Codes for New Construction

In addition to appliance standards, another method of mandating energy efficiency is to mandate higher efficiency standards for new construction. As mentioned previously, experts estimate that more efficient codes would provide 30% more savings for a new home, than the existing codes used in Maine. By mandating more efficient codes, new homes would be more efficient.

The drawback to relying on building codes to provide energy efficiency is the difficulty in enforcement. In order to ensure effective administration, adequate training and enforcement must accompany the codes. In states where these codes are successful in improving efficiency, building codes are enforced by regional or state agencies with the appropriate staff and training resources to properly address the needs.

Funding Sources for Conservation Programs

New energy efficiency programs would require new funding from the state or other sources, the total investment required could be from \$5 million to \$20 million over the next ten years depending on the policy goals of the programs.³⁷ There are several sources available to finance conservation programs in the state. Most of these sources are already designated for planned programs or are very limited in funds. Moreover, the current Bush Administration Energy Plan Proposal makes even further cuts in funding for conservation at the federal level. Thus, funding for any new conservation initiatives would have to come from new sources or state funding. See Appendix A for a list of potential funding sources.

Existing Sources of Funding

- **Maine Electric Energy Conservation Program Fund**- an assessment on electricity distribution bills earmarked for conservation programs. The fund is \$4 million and covers commercial and industrial conservation programs as well. The State Planning Office oversees program planning.
- The **DOE Weatherization Program**- will provide \$3.1 million to Maine in 2002. In addition, MSHA allocates 15% of the LIHEAP funding for weatherization services.
- **Rebuild America, the DOE partnership program**, provided \$30,000 in technical assistance to Maine Power Options for technical assistance in 2001.
- **State Energy Program of the DOE** provided \$336,000 to the state of Maine for implementation of the State Energy Plan, the funding is used for all programs including residential, commercial and industrial. Additional grant funding is also available to Maine for specific projects.

Potential New Sources of Funding

The following provides a list of possible funding sources for energy efficiency programming that require further exploration-

- **State Sponsorship**- there is an opportunity for the state to finance a program through its annual revenues or by providing incremental financing.
- **Federal sponsorship**- The National Energy Plan released this year from the White House discusses the importance of energy efficiency in a national strategy. The final

³⁷ For example, the current census of the LIHEAP program in Maine shows that of the lowest-income households in the state that qualify for LIHEAP, 5,595 do not have adequate attic insulation. A program to address the needs of just these households would cost \$15,666,000, based on the current weatherization-program average grant of \$2800 per household.

funding levels are not yet determined, however, early projections show reductions in investment

- **NORA- National Oil Heat Research Alliance** – this new fund, created from an assessment on heating oil purchases, appears to have the most potential for financing new efficiency programs in the state.
- **Private funding** – organizations like The Energy Foundation provide grant opportunities to further energy efficiency and advocacy throughout the U.S.

Summary and Conclusions

Maine has the potential to reduce per capita residential energy use by 25% over the next ten years, with additional investment in efficiency programs. Through the mandated appliance standards, household initiated improvements, existing and planned programming and additional investment in efficiency programming, it is possible to achieve the 25% per capita savings across the residential market in the state (see Table 6).

Table 6. Summary of Potential Energy Efficiency Programs and Potential Savings

Market Intervention	Program	Percent Reduction of Total Household Energy Use³⁸
Savings that will Happen Anyway	Appliance Standards New Housing Naturally occurring	6-8%
Planned Programs	Maine Electric Energy Conservation Program Sustained Information campaigns by Maine Oil Dealers Association	6-8%
Education Program Investment	Broadcast Information campaign Promotion of Existing Programs -ENERGY STAR -HERS and Energy Efficient Mortgages	1-5% Depends on the level of investment
Incentive Programs-Investment	Lighting Rebate Energy Audit Rebate Energy-Efficiency Tax Credit Appliance Replacement for Targeted Populations Retrofit for Targeted Populations	2-10% Depends on the level of investment
Mandated Standards	More Stringent Appliance Standards More Stringent Building Codes	2% depending on code

For households who cannot afford to replace appliances, the savings per household would be lower than the statewide household savings. Thus, targeted investment in

³⁸ Savings calculations are based on energy usage reductions for all residential households in Maine over ten years. Results for an individual household may vary.

efficiency would be required to achieve the same level of savings for those with fewer means: the low and moderate income households.

While the report describes many potential and promising areas for reducing energy, there are a few areas that stand out. The data show that space and water heating use the most energy in a typical household, as much as 80%. Thus, improvements to the home or the heating system, that help a household use less heat and hot water, are likely to have the most opportunity for savings. For the low income groups, this is even more significant as they tend to use fewer energy powered appliances than the non-low income groups, using even more than 80% of their total energy for heating.

The ultimate cost of any new or enhanced energy efficiency programs could be determined through a program planning process. Generally, the additional costs would be in the range of \$5 - \$20 million, and would need to be further refined to encompass state policy objectives and implementation considerations.

Specific observations on programming and the potential to achieve the target level of savings are as follows-

Over the next ten years, some households will take actions on their own to reduce energy use, others will participate in several energy industry and federal programs. These household initiated steps and planned programs may save as much as 12-16% of total household usage. In addition, Maine State Housing will continue to provide service to the lowest income groups, providing significant savings for those households.

- **National Standards and appliance labeling programs will provide savings to Maine.** The National efficiency standards will provide savings to Maine by mandating minimum levels of efficiency for new appliances. In addition, the ENERGY STAR appliance- labeling program will direct Maine consumers to more efficient models of appliances. The program could provide more savings through more rigorous promotion in Maine.
- **New electricity and oil conservation programs will promote energy efficient purchases in the marketplace.** The Maine State Planning Office, in a collaborative effort with stakeholders, has designed an electric energy conservation plan using a market-oriented approach to educate consumers on the benefits of purchasing efficient equipment. The Maine Oil Dealers Association has also launched a Smart Energy campaign to promote efficiency in using oil and purchasing oil-based heating systems. Both programs are funded through adders to respective energy bills.
- **Several programs administered by the Maine State Housing Authority address the energy needs of the lowest income households in the state, but there is more work to be done.** In addition to state and federal heating assistance, the Maine State Housing Authority delivers additional energy efficiency services through the CAP agencies to the neediest households in the state. These programs are effective in

installing energy efficiency measures in the homes of their clients, but they do not have enough funding to serve all of the low-income households in the state.

Additional investment in new programming has the potential to help Maine reach the goal of reducing residential energy use by 25% by the year 2011. New and enhanced energy-efficiency programming might cost as much as \$5 million to \$20 million over the next ten years and save 3-15% of total household energy use.

One approach for programming is to enhance or invest in existing programs by providing additional education and marketing resources. This approach builds on existing infrastructure and can reach a wide audience with an efficiency message. Another approach is to provide specific incentives to encourage the use of an efficient appliance or household improvement. This approach has been effective in targeting specific populations of households as well as promoting a specific end use such as efficient lighting.

Additional investment in promoting and building awareness for the value of energy efficiency can lead to more savings, 1-5% more, and help consumers take steps on their own. Programming may include-

- **Augment the statewide energy efficiency campaign** to provide energy saving tips and promote the value of reducing energy use,
- **Supplement the Energy Star appliance labeling** program to help consumers identify energy efficient appliances where they shop, and
- **Increase awareness of energy-efficient mortgages** to give consumers more access to financing efficiency home improvements.
- **Promote higher levels of efficiency in the new home market** to capture efficiency opportunities while the dwelling is under construction.

The provision of incentives and subsidies for energy efficient programs and appliances will yield additional savings, as much as an additional 10%. These types of programs are particularly effective in targeting special groups for savings. Subsidies and financial incentives may also help those who cannot otherwise afford to pay for efficiency upgrades. The level of the incentive will impact participation rates and will need to be considered in program design. Incentive programs include-

- Residential lighting programs to subsidize the high upfront cost of an efficient light bulb.
- Energy Audit rebate programs refund the initial investment in the audit upon proof of investment in prescribed improvements.
- Energy efficiency tax credit provides financial incentives in the form of a tax credit to households investing in efficiency upgrades.
- Appliance replacement programs replace older, less efficient appliances. The incentive can vary from a tax credit or discount to a complete appliance swap program.

- Targeted retrofit program provides home improvements that address the thermal integrity of the house. Like the other programs, the level of investment can vary from small incentives to complete subsidy.

Maine will benefit from new appliance standards and may consider additional standards as a means to increase energy efficiency by as much as 2% and reduce energy use in the state. Working with other states in the northeast region, there may be sufficient economies and benefits to adopt new appliance standards. In addition to appliance standards, upgrading the energy building codes appear to achieve savings in a technical analysis, however, enforcement will be difficult, and therefore may not yield any real savings.

Additional investment will lead to additional energy savings in the state. To achieve the target level of savings, a significant amount of funding may be required. This investment will be particularly important to overcome customer inertia and income inequities in the state. Even to develop more specific cost-benefit estimates, and to apply for additional federal or private funding, staff resources are required at the state level. There are several sources providing program funding today that may hold promise for future funding-

- System benefits charge on electric distribution company bills in the state;
- U.S. DOE LIHEAP and weatherization program funding,
- U.S. DOE State Energy Program funding,
- Industry and trade group funding such as the National Oilheat Research Alliance, and
- Private funding such as from The Energy Foundation.

Energy Efficiency needs more focused attention as a state policy matter. In the process of researching this topic, it became apparent that there is very limited current data on energy use or future use in Maine. Moreover, there are few data available that track the total energy used by a household or special segments of the population such as low-income groups. Additional research is necessary to describe household energy use in Maine, particularly for the low-income and moderate-income groups, to-

- forecast energy usage over the next ten years,
- understand program costs and response rates for various efficiency program designs,
- benchmark programs in other states, and
- design cost-effective programs for implementation in Maine.

References

- Alexander, Barbara, Background and Needs Analysis: Maine's Low Income Bill Payment Assistance Programs, A Report to the Maine Public Utilities Commission, Maine, December 14, 2000.
- Central Maine Power Company, The Electric Lifeline Program Evaluation, Augusta, Maine, filed with the Maine Public Utilities Commission, 1993.
- Choate, Jo-Ann L., 2000-2001 Low Income Home Energy Assistance Program, A Statewide Descriptive Analysis, Maine State Housing Authority, Maine, 2001.
- Davulis, John, Sales Forecast, Volume III-A, Central Maine Power Company, Augusta, Maine, Pre-filed Direct Testimony to the Maine Public Utilities Commission, Investigation of Central Maine Power Company's Stranded Cost Revenue Requirement and Rate Design, docket No. 2001-232 Phase II. October 3, 2001.
- Economic Opportunity Research Institute, "A Profile of the Energy Usage and Energy Needs of Low-Income Americans", Washington D.C. March 28, 1999, available at the LIHEAP Clearinghouse web site:
<http://www.ncat.org/liheap/pubs/profiles.htm>
- Energy Center of Wisconsin, "Circuit Riders toot the Energy Star Horn", Spring 2001 Newsletter.
- Fitzgerald, John, "Working Hard, Falling Behind: A Report on the Maine Working Poor Parents Survey", found at www.mecep.org/report-whfb/whfb_report.htm, Bowdoin College, Maine, 1997.
- Geller, Howard, Toru Kubo and Steven Nadel, "Overall Savings from Federal Appliance and Equipment Standards", ACEEE, February 2001
- Karg, Richard, "Summary of the Maine Residential Energy Standard, prepared for the Maine State Planning Office, November 13, 2001.
- National Oil Heat Research Alliance, website, www.nora-oilheat.org.
- Maine Oil Dealers website, www.meoil.com
- Maine State Housing Authority, web site, www.mainehousing.org
- Martin, Michael, The Process of Setting Appliance Standards, submitted to California Energy Commission, 1995.
- Maine State Planning Office, Maine Electric Energy Conservation Plan, November 2001.

Maine State Planning Office “State of Maine Energy Programs Resource Guide”, 2000.

Nadel, Steve, “Opportunities for Energy and Economic Savings from Adoption of Appliance and Equipment Efficiency Standards on Additional Products”, American Council for an Energy-Efficient Economy, July 2001.

Northeast Energy Efficiency Partnerships, Northeast Equipment Standards Project, policy statement documents.

Office of Building Technology, State and Community Programs, Energy Efficiency and Renewable Energy, U.S. Department of Energy.

U.S. Census 2000 Supplemental Survey Summary Table, found at http://factfinder.census.gov/home/en/datanotes/exp_c2ss.html.

U.S. Department of Energy, Residential Energy Consumption Survey, 1997

U.S. Department of Housing and Urban Development, Energy Desk Book for HUD Programs, web site, found at www.huduser.org.

U.S. Department of Energy, Energy Information Administration, 1999 data found at www.doe.gov/eia.

U.S. Department of Energy, “U.S. Electric Utility Demand-Side Management: Trends and Analysis”, found at [ww.eia.doe.gov/cneaf/pubs_html/feat_dsm/contents.html](http://www.eia.doe.gov/cneaf/pubs_html/feat_dsm/contents.html)

U.S. Department of Energy, “Financing Energy Efficiency in Buildings”, Rebuild America Guide Series, Washington, DC, 1998.